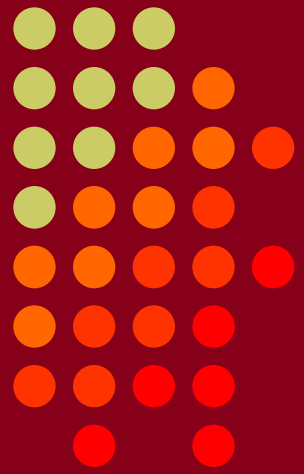
CTU Presents

Optimizing VHF Contest Scores Utilizing JT Digital Modes

Joel Harrison, W5ZN



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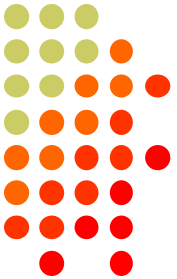
Before We Talk "Digital" Let's Review Some Basic Topics



- Antenna Techniques
- Station Techniques
- Propagation Techniques
- Operating Techniques

Antenna Techniques

- **What Kind of an Antenna?**
  - **Yagi**
    - **Horizontal polarization**
  - ~~**Vertical**~~
  - ~~**Dipole / Inverted Vee**~~
- **How Many Elements?**
  - **More is better up to a point.**
  - **7 is good**
- **How High Should it Be?**
  - **30 Ft ?**
  - **Let's look at some plots**

Antenna Techniques

- **What is the best height for my antenna?**
  - You will always have dead zones and nulls regardless of height
  - Get your antennas as high as you reasonable can
- **How Many Antennas do I need?**
  - **Really depends on where you live**

Antenna Techniques

QTH in Maine / Northeast USA

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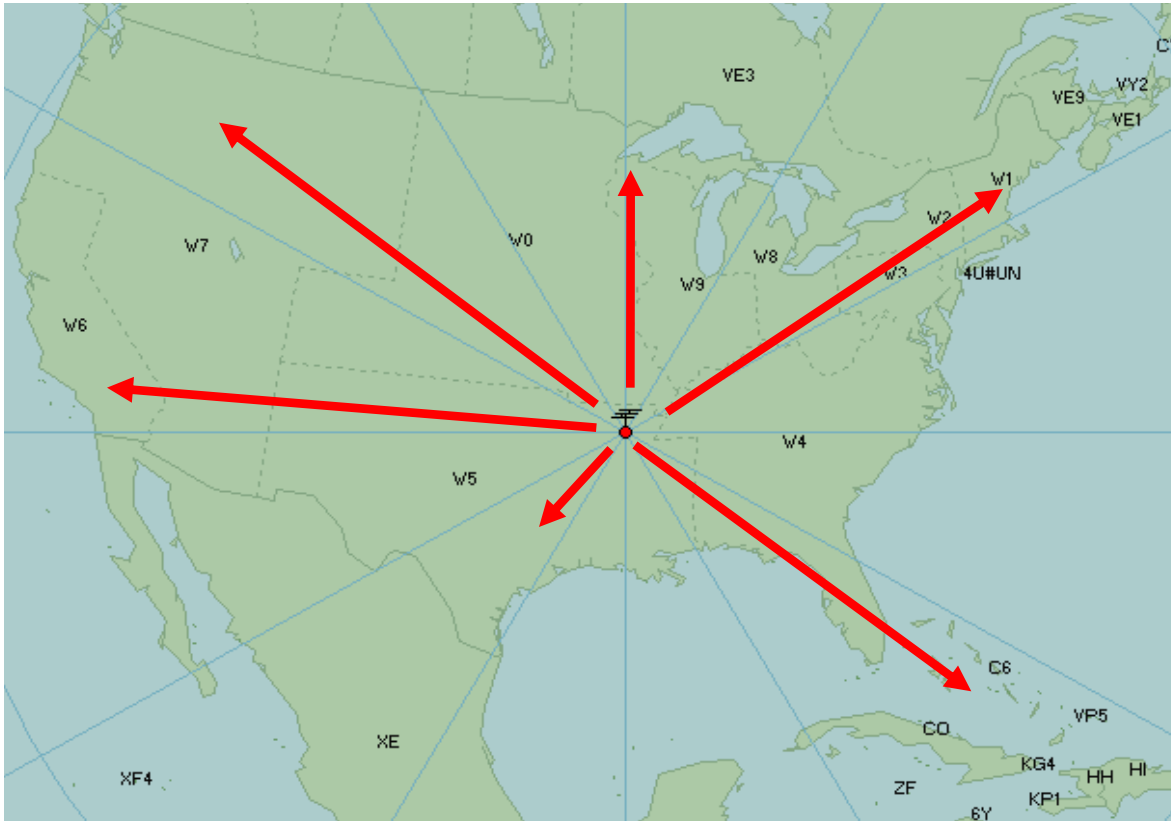
Antenna Techniques

QTH in Mid USA



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Antenna Techniques

How can you quickly change antenna direction??

Antenna, or a stack of smaller antennas in a fixed direction allow fast direction change without waiting for a rotor to turn.

Station Techniques

- Radio
- Preamp
- Interconnecting cables
- Noise

Station Techniques

- Radio
  - All new radios include 6 meters
  - Good dynamic range, roofing filters essential
- Preamp
- Interconnecting cables
- Noise

Station Techniques

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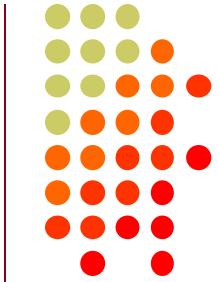
Station Techniques



- **Radio**
  - All new radios include 6 meters
  - Good dynamic range, roofing filters essential
- **Preamp**
  - Will improve weak sigs when band is dead but can cause problems in presence of strong stations
- **Interconnecting cables**
  - Ensure solid connections
  - Avoid cheap phono connectors & cable
- **Noise**

Station Techniques

Noise! The Grim Reaper of noise is *not* your friend!!

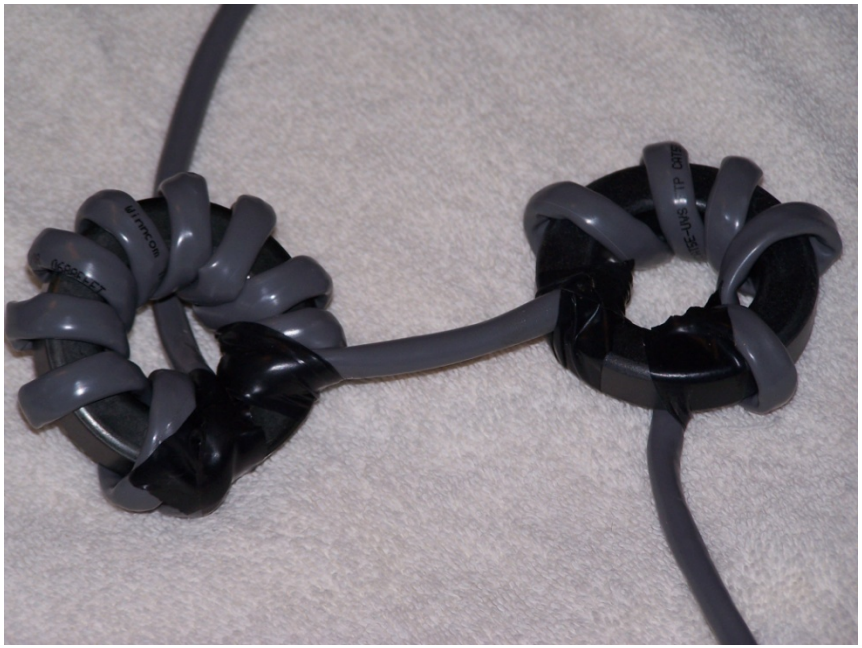
- Sky Noise
- Atmospheric Noise
- Line Noise
- Other man-made noise

Station Techniques

- **Internet Routers can be a significant noise source at 50 MHz that will populate the band, especially the DX Window**
  - Multiple carriers of relatively constant amplitude but with modulation (Birdies)
    - 50.044, 50.058, 50.105, 50.120, 50.148, 50.166
  - Broadband trash
- ***Get your own station "clean" first!***

Station Techniques

Internet Router noise can be significantly reduced or eliminated.



Also utilize shielded CAT5 cable and connectors

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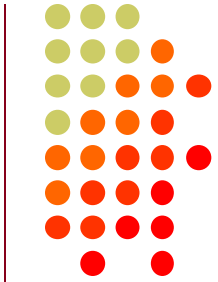
Station Techniques



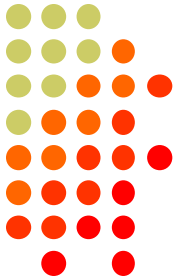
- **Some Actual Results**
  - All “birdies” are gone
  - Noise floor dropped 8 dBm !!!
- **More technical info:**
  - A Ham’s Guide to RFI, Ferrites, Baluns and Audio Interfacing - Jim Brown, K9YC
    - http://audiosystemsgroup.com

Station Techniques

Noise – Recap

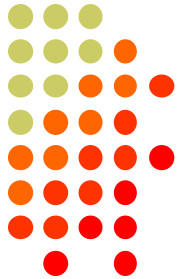
- Clean up your own station
- Address line noise issues
- Use Bandpass Filters

Propagation Techniques



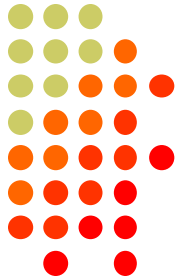
- **Meteor Scatter – “MS”**
- **Moonbounce - EME**

Meteor Scatter



- Meteor scatter is the reflection of radio waves from the ionized trails from meteors burning up in the upper atmosphere.
- Meteors (space debris) burn up in the upper atmosphere at a height of around 65 miles.
- This may be used to make QSOs up to about 1400 miles

Meteor Scatter

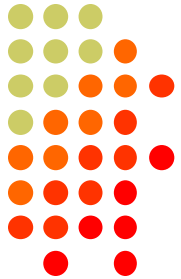


- The earth is bombarded by a constant stream of small particles, remnants of comets that when entering the earth's atmosphere can ionize a column of atoms in the E region at approximately 100km (~60 miles) above the surface of the earth which can reflect radio waves in the VHF region of the spectrum

Meteor Scatter

- There are seasonal variations in the number of sporadic meteors
  - Relative rate increases noticeably in May, peaking in July and August then tailing off into October and November.
- There is also an hourly variation in the relative rate of meteors peaking
  - around dawn local time with the minimum late afternoon before the ramp up begins again late evening.
  - The hourly relative rate is due to the fact that the earth's rotation is head on so to speak in the morning into the path of the particles and therefore there is an increase in the relative velocity of a particle entering the earth's atmosphere.

Meteor Scatter



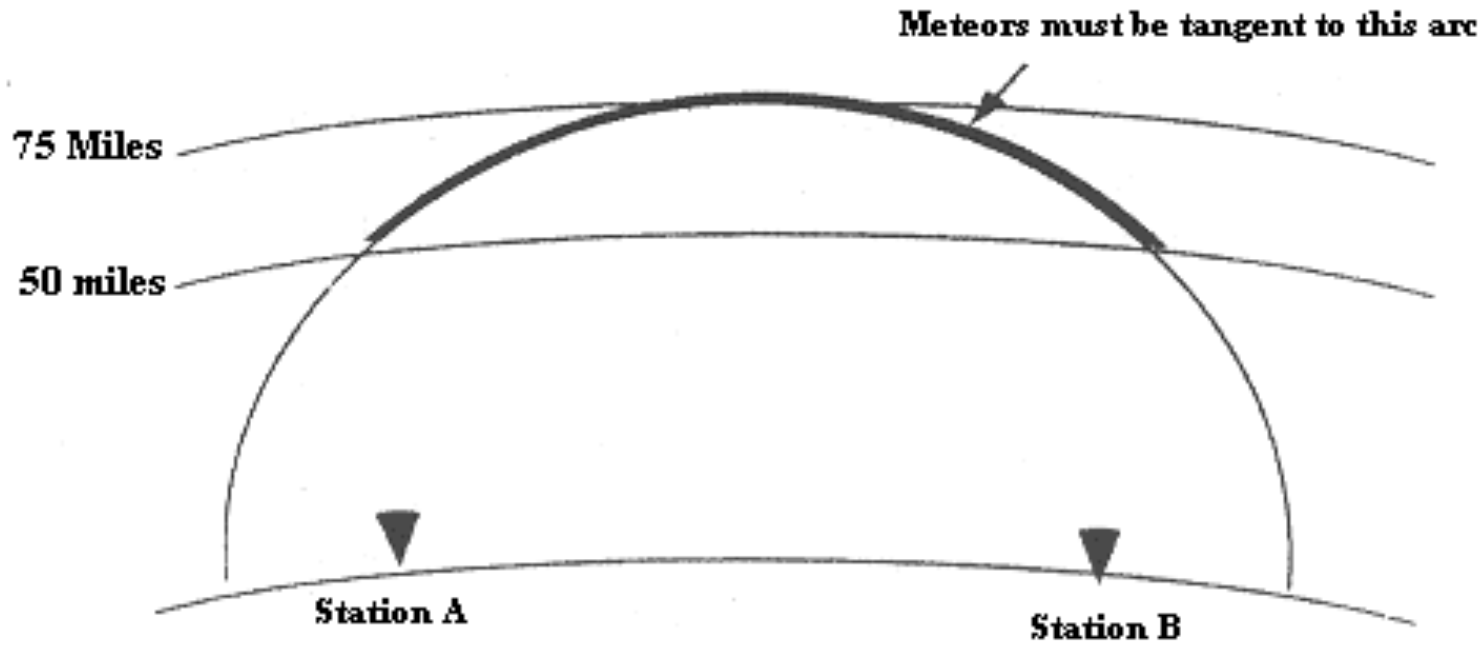
- The length of time of the ionization, or burst duration, is related to meteor velocity and increase in relative velocity results in longer ionization times.

Meteor Scatter

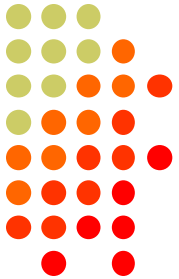
- Most particles entering the earth's atmosphere are the size of a grain of sand resulting in ionization lasting only a fraction of a second
  - much too short to convey any meaningful information using SSB or even high speed CW.
- The digital modes of FSK441 and MSK144 were designed to compress a limited amount of information in a packet and transmit that packet in a very short period of time.
  - In the case of MSK144 the information packet, with a transmission length 0.072 seconds, is repeated over and over again during the duration of the selected transmit interval of 5, 10, 15 or 30 seconds.

Meteor Scatter

Reflection will occur when the trail is oriented as shown

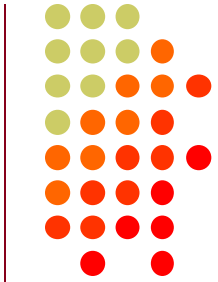


Meteor Scatter



- **Excellent for 50 MHz**
- **Very Predictable Paths**
  - Best times between midnight & approx 9 AM
  - Peak during “showers” – Anytime with high speed procedures like ***WSJT***

Operating Techniques

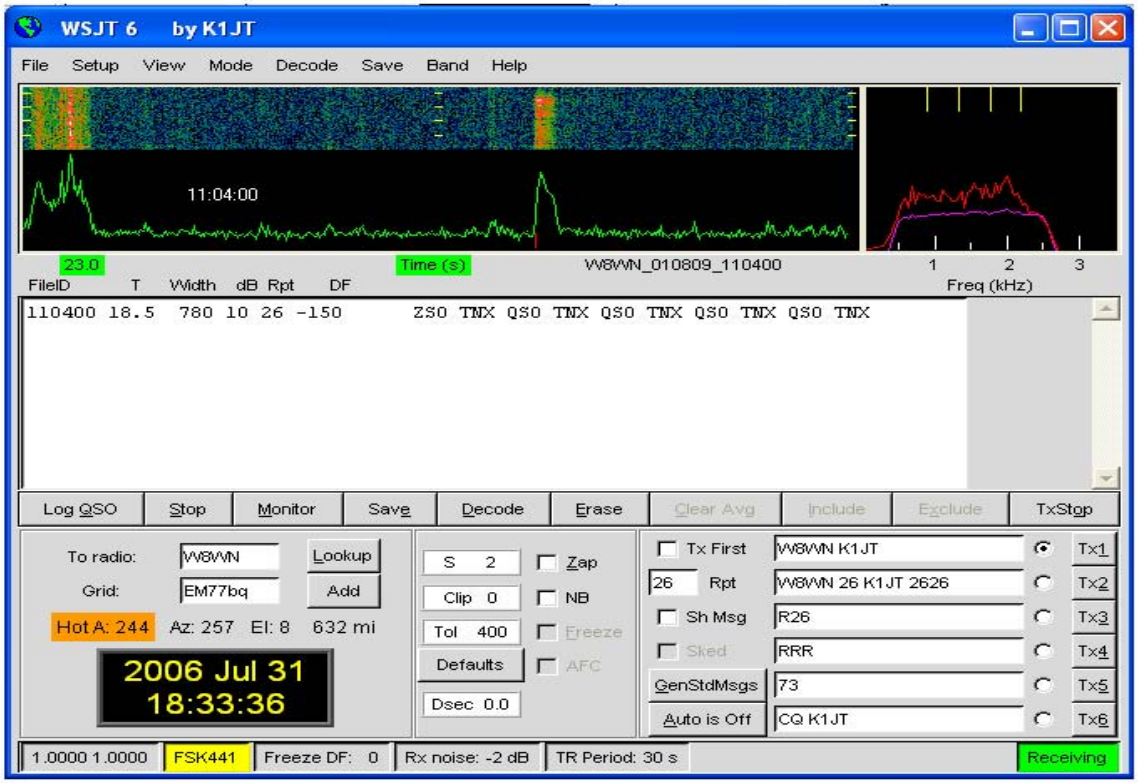


K1JT Digital Modes

- **Weak Signal Communication by K1JT (WSJT) offers specific digital protocols optimized for EME and meteor scatter at VHF/UHF**
- **Free open-source programs. Normal usage requires only a standard SSB transceiver and a personal computer with soundcard.**
- **Can Provide Outstanding access to new grid multipliers from moderate stations**

Meteor Scatter

Original JT “FSK441” MS Mode



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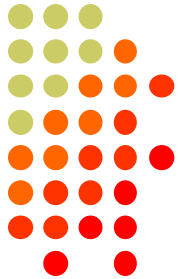
Meteor Scatter

- **New Mode introduced in WSJT-X**
  - Officially released in January 2017
  - Contains 8 new modes
  - **MFSK441 Mode**
    - **Calling frequencies 50.280**
    - **Many new features**

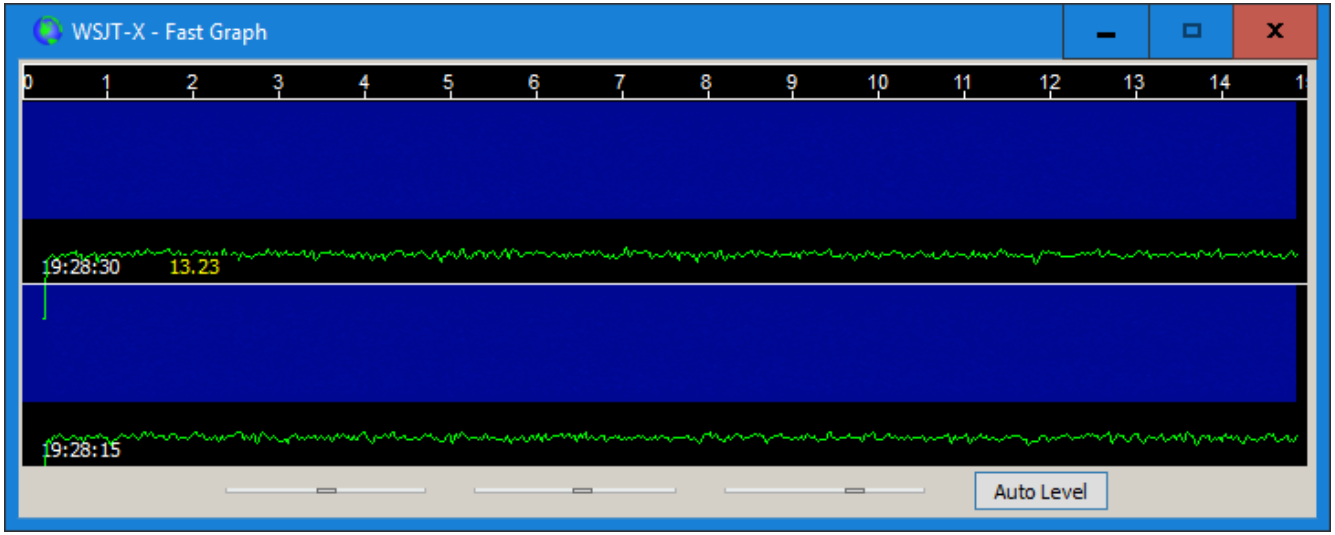
Meteor Scatter



- Focussed toward contest style operation that include:
  - a machine human interface that facilitates rapid population of QSO specific information
  - shorter TX and RX periods than FSK441
  - auto sequencing that reduces human error and improves operator efficiency important considerations during contest operation

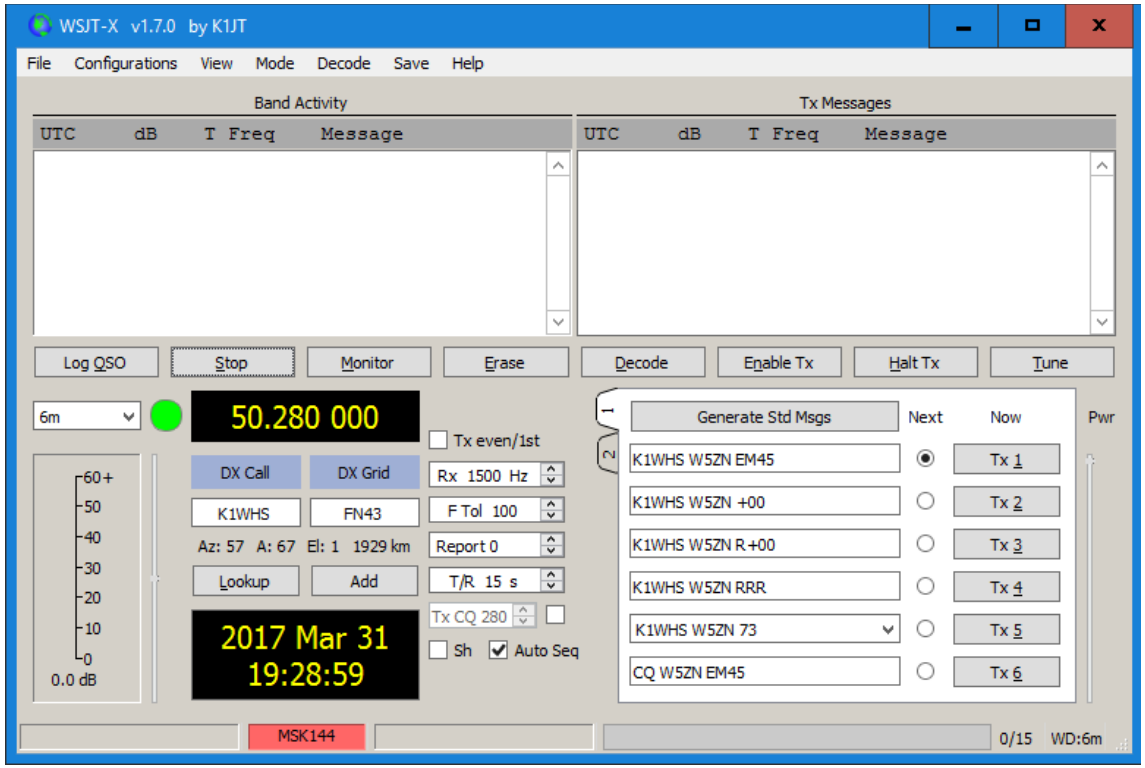
Meteor Scatter

Graph still exists but in a separate window called “Fast Graph”



Meteor Scatter

MSK144 Window is different from previous FSK441 Window”



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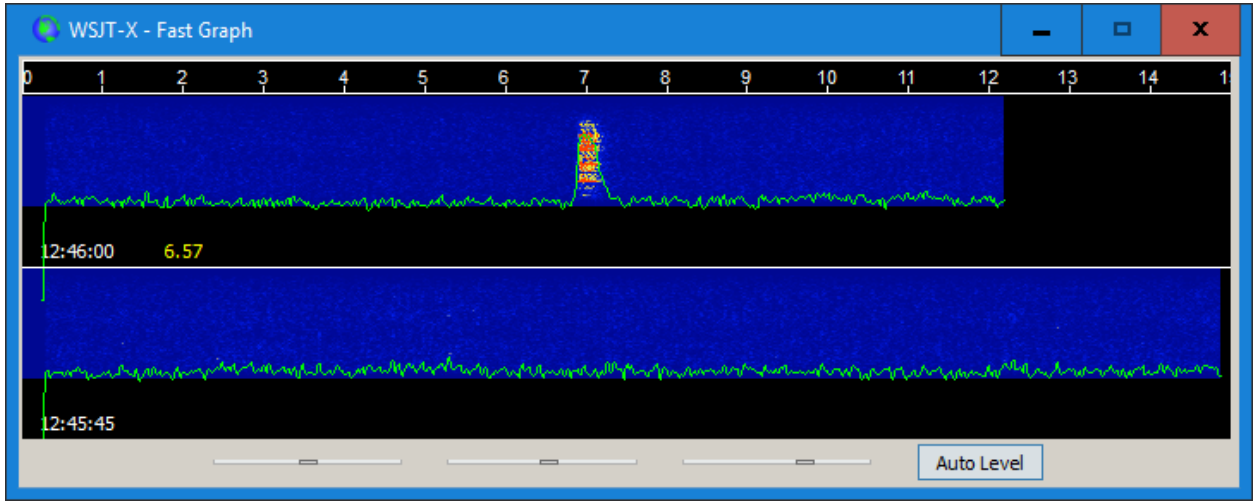
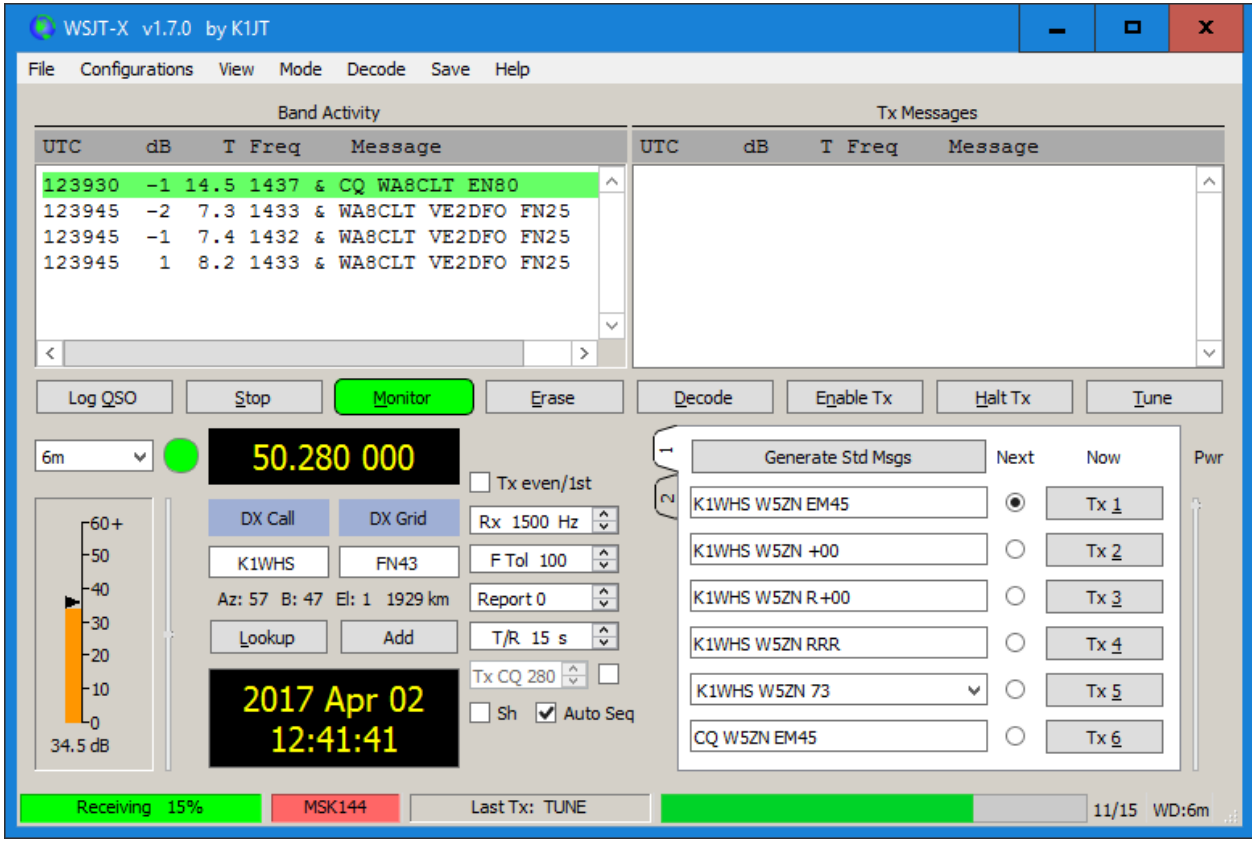
Meteor Scatter

Signal bursts still appear in the “Fast Graph”



Meteor Scatter



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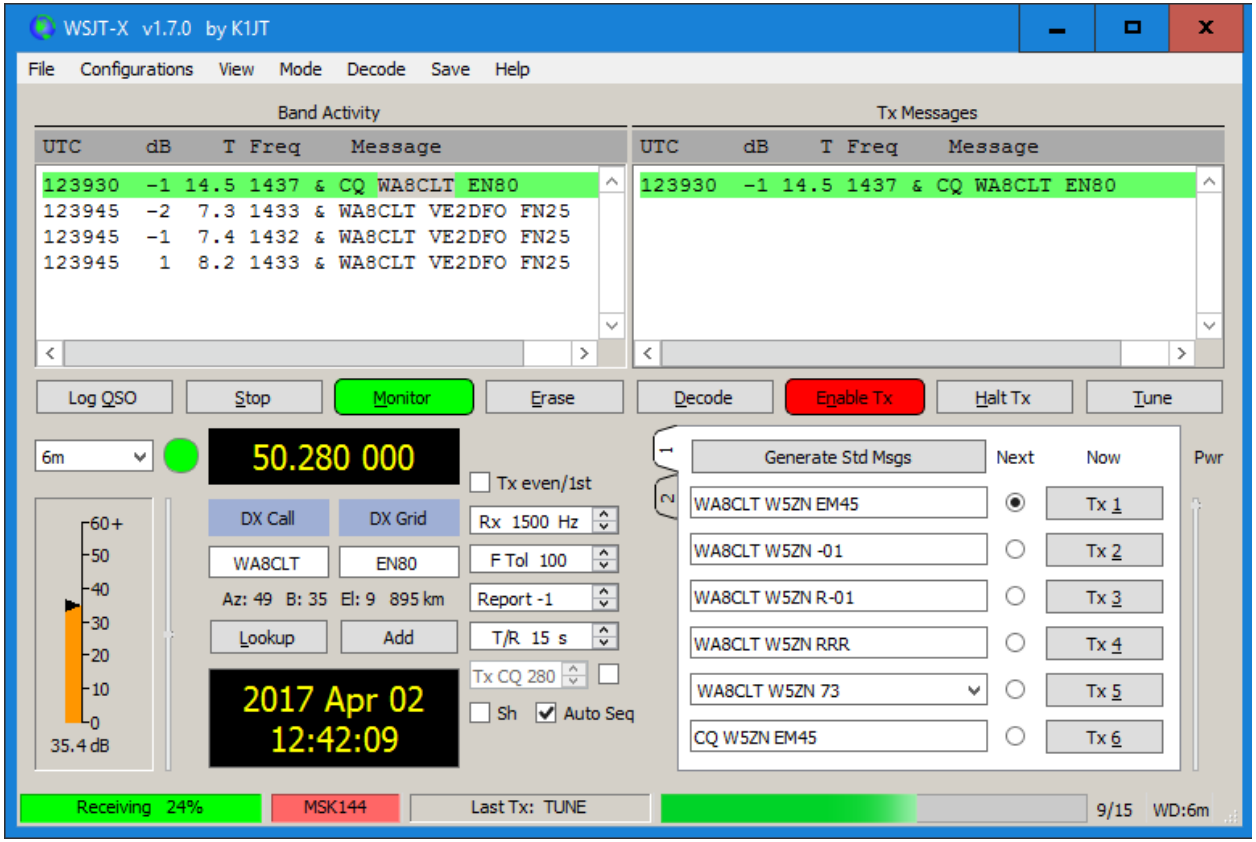
Meteor Scatter



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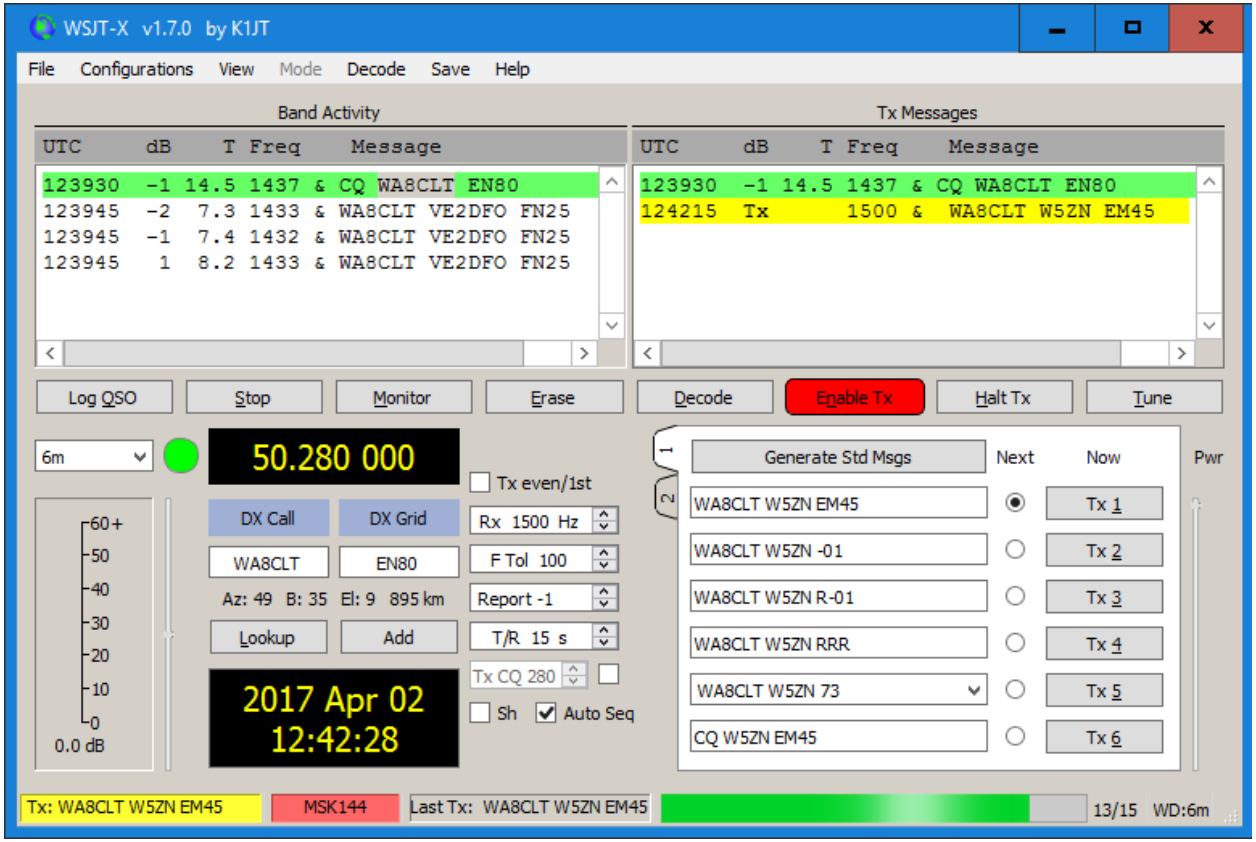
Meteor Scatter



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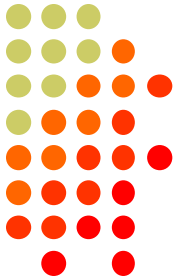
K8ZR Test Results



- **Contest QSO Non-Contest QSO**
- **Tx Time:**
- 15 sec. CQ N8JX EN64
- 15 sec. N8JX K8ZR EN91
- 15 sec. K8ZR N8JX R EN64
- 15 sec. N8JX K8ZR RRR
- 15 sec. K8ZR N8JX 73
- Total time: 75 seconds

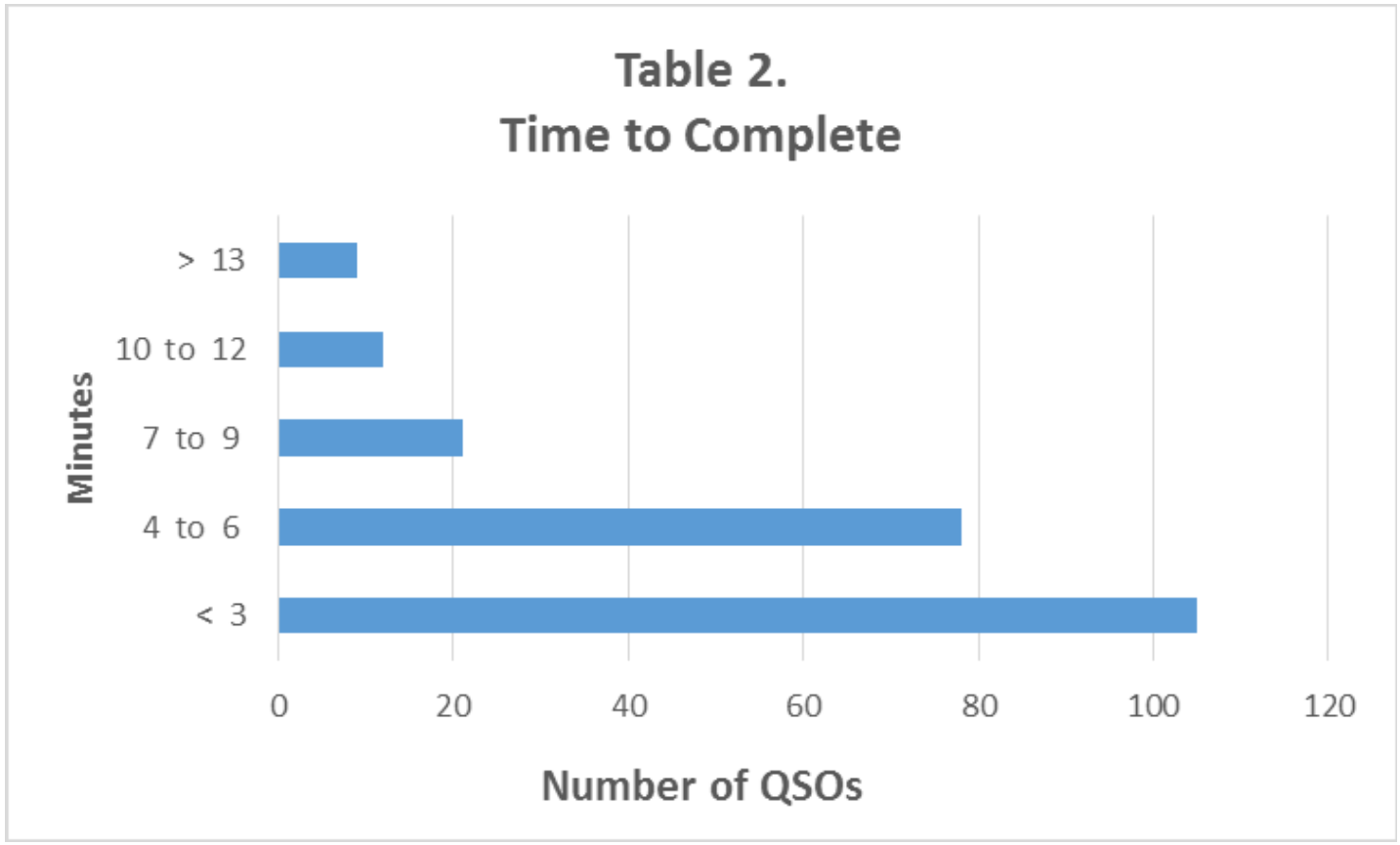
- **Non-Contest QSO**
- **Tx Time:**
- 15 sec. CQ WB4JWM EM83
- 15 sec. WB4JWM K8ZR EN91
- 15 sec. K8ZR WB4JWM +05
- 15 sec. WB4JWM K8ZR R+07
- 15 sec. K8ZR WB4JWM RRR
- 15 sec. WB4JWM K8ZR 73
- Total time: 90 seconds

K8ZR Test Results

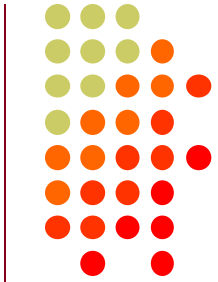
50 MHz MSK144 QSO Summary

Period January 23rd- March 13th:	50 days
Number of 50 MHz MSK144 QSOs:	225
Average number of minutes to complete a QSO:	4.6
Number of unique callsigns worked:	50
Number of unique callsigns decoded:	98
Number of States worked:	22
Number of unique Grids worked:	42
Number of 90 second QSOs:	10
Best DX K5DOG EM00wh:	1,223 miles

K8ZR Test Results



Important Techniques



- **The Same Principles for HF Apply to VHF**
  - Tower & Electrical Safety
  - Station Ergonomics
  - Physical Fitness
  - **ETHICS !!!**
    - A system of moral values and motivation based on right and wrong
      - "The rules are black and white, we make them gray!"
        K5ZD, CTU Dayton 2009

Where to Learn More

- VHF Conferences & Microwave Update
  - Central States VHF Society (CSVHFS)
  - Northeast Weak Signal Society (NEWS)
  - Southeast VHF Society (SEVHFS)
  - Western States Weak Signal Society (WSWSS)
  - Microwave Update Conference
  - Not “traditional” hamfests
  - Publish proceedings (compilation of technical papers)

Acknowledgement

- Thanks to Tony, K8ZR (x-WA8RJF) for supplying additional information on Meteor Scatter